

PATENT ABSTRACTS OF JAPAN

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(54) CONDUCTIVE RESIN COMPOSITION AND PTC THERMISTOR USING THE SAME

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a conductive resin composition which has low volume resistivity and a good PTC(positive temperature coefficient) characteristic and of which a PTC thermistor can be easily manufactured, and further to provide a PTC thermistor using the conductive resin composition.

SOLUTION: This conductive resin composition is formed by dispersing a conductive substance in a mixture, composed of a polyethylene and another polyethylene of which molecular chain terminal is modified with a polar compound such as maleic anhydride, acrylic acid. The content of polar compound in the mixture is preferably 0.1 to 50 wt.%. A PTC thermistor is constituted of this conductive resin composition.

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CLAIMS

[Claim(s)]

[Claim 1] The conductive resin constituent characterized by making the mixture which consists of a polyethylene simple substance to which the chain end denaturalized with the polar compound, or polyethylene and the polyethylene in which the chain end denaturalized with the polar compound come to distribute the conductive matter.

[Claim 2] a polar compound -- 0.1 - 50wt% -- the conductive resin constituent according to claim 1 characterized by coming to contain.

[Claim 3] The PTC mold thermistor characterized by using claim 1 and a conductive resin constituent according to claim 2.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] the PTC mold thermistor with which a conductive resin constituent and it were used for this invention -- being related -- a PTC property (forward temperature coefficient property) especially low [a volume resistivity] and good -- having -- in addition -- and it is related with the PTC mold thermistor using said conductive resin constituent which it is used under the conductive resin constituent excellent in adhesive strength with a metal and the condition used as an overcurrent, and the conditions on which temperature rises rapidly etc., and can be manufactured easily.

[0002]

[Description of the Prior Art] A PTC mold thermistor is an electronic device used under the condition used as an overcurrent, and the conditions on which temperature rises rapidly etc., and it is obtained by laminating a metallic foil to both sides of the film which consists of a conductive resin constituent, a sheet, etc. As a conductive resin constituent used for this PTC mold thermistor, the thing which makes resin, such as a crystalline polymer and an amorphous nature giant molecule, come to distribute conductive matter, such as carbon black, metal powder, and graphite, is used.

[0003] the PTC mold thermistor in which the conductive resin constituent using crystalline polymers, such as polyethylene, has a low volume resistivity, and a steep PTC property is shown by the temperature rise can be formed -- it excels. The chain of the conductive matter is cut by the cubical expansion of the crystalline polymer by the temperature change, and this PTC property is discovered when resistance goes up in connection with it. For this reason, in the PTC mold thermistor obtained using this, the conductive resin constituent using the crystalline polymer in which a steep PTC property is shown can prevent the thermal run away by the rapid temperature rise, when ambient temperature rises, and it has the advantage of the ability to make it hard to happen burning.

[0004] However, in the conductive resin constituent using this crystalline polymer, on the occasion of manufacture of the PTC mold thermistor which used this, since the adhesive strength of a crystalline polymer and a metal was weak, there was inconvenience that a lamination was difficult. In order to mitigate this inconvenience, what introduced the polar compound into the chain of a crystalline polymer, for example, an ethylene-vinylacetate copolymer, an ethylene-ethyl acrylate copolymer, etc. are used, and the conductive resin constituent which raised adhesive strength is used.

[0005] However, since degree of crystallinity was controlled with the polar compound in a crystalline polymer, that PTC property was also controlled, the inconvenience that a steep PTC property was not acquired arose, and this conductive resin constituent had become a problem.

[0006]

[Problem(s) to be Solved by the Invention] that by which this invention was made in view of said situation -- it is -- a PTC property low [a volume resistivity] and good -- having -- in addition -- and it is making to offer the conductive resin constituent excellent in adhesive strength with a metal into the technical problem. Moreover, it is making to offer the PTC mold thermistor using this conductive resin constituent into the technical problem.

[0007]

[Means for Solving the Problem] Said technical problem is solvable with the conductive resin constituent which makes the mixture which consists of a polyethylene simple substance to which the chain end denaturalized with the polar compound, or polyethylene and the polyethylene in which the chain end denaturalized with the polar

compound come to distribute the conductive matter. moreover, the inside of mixture -- a polar compound -- 0.1 - 50wt% -- it is desirable to consider as the conductive resin constituent which it comes to contain. Furthermore, said technical problem is solvable by considering as the PTC mold thermistor which used this conductive resin constituent.

[0008]

[Embodiment of the Invention] Hereafter, this invention is explained in detail. As polyethylene used for the conductive resin constituent of this invention, the thing of 0.1-20 has a desirable melt index, and straight chain-like low density polyethylene, low density polyethylene, high density polyethylene, etc. are used.

[0009] moreover -- as the polyethylene (henceforth "denaturation polyethylene") in which the chain end here denaturalized with the polar compound -- a melt index -- the thing of 0.1-20 -- the thing of 1-10 is used preferably. When said melt index uses less than 0.1 thing, since the load concerning the extruder at the time of shaping is too large, it is not desirable. Moreover, when the thing exceeding 20 is used, since it is difficult for the fluidity at the time of shaping to be too good, and to fabricate in a predetermined configuration, it is not desirable.

[0010] as denaturation polyethylene -- a polar compound -- 0.1 - 50wt% -- the thing which it comes to contain is used preferably. When said content is made into less than [0.1wt%], since adhesive strength with a metallic foil is insufficient and formation of an electrode becomes difficult, it is not desirable. Moreover, when a content exceeds 50wt(s)%, there is little cubical expansion near the melting point, and since it becomes impossible to discover a steep PTC property, it is not desirable.

[0011] Moreover, the polyethylene which could use the polyethylene in which only the end of a chain denaturalized with the polar compound as denaturation polyethylene used here, for example, denaturalized with polar compounds, such as acrylic ester, such as a methyl acrylate and an ethyl acrylate, vinyl acetate, an acrylic acid, a methacrylic acid, and a maleic anhydride, is used preferably.

[0012] Pori Bond 1009 (made in uni-ROIYARU Chemicals (United States)) who denaturalized with the acrylic acid, Pori Bond 3009 (made in uni-ROIYARU Chemicals (United States)) who denaturalized by the maleic anhydride are still more specifically used preferably.

[0013] Moreover, as conductive matter used here, conductive carbon black, graphite, metal powder, etc. are used. that whose particle size furnace black, thermal black (inactive black), channel black (activity black, hard black), etc. are used preferably, and is 18-75 micrometers as conductive carbon black here -- a 30-75-micrometer thing etc. is used preferably. Moreover, as graphite, the thing of the shape of a Lynn piece of a natural graphite and an artificial graphite, a soil massive thing, etc. are used.

[0014] Although the mixed rate of polyethylene and denaturation polyethylene in mixture is a weight section ratio and it is desirable to consider as the range of polyethylene:denaturation polyethylene 0:100-90:10, if a mixing ratio is set that the polar compound contained in this mixture whole quantity becomes 0.1 - 50wt%, it will not be restricted to this range. Therefore, what is necessary is just to decrease the rate of denaturation polyethylene in the thing using denaturation polyethylene with many contents of an activity compound.

[0015] Since adhesive strength with a metal is not fully obtained when the content of the polar compound in the mixture whole quantity is made into less than [0.1wt%], it becomes [the lamination of a metallic foil] difficult on the occasion of manufacture of a PTC mold thermistor and is not desirable. Moreover, when a content exceeds 50wt(s)%, since resin pastes the metal part of a kneading machine and the suitable kneading effectiveness is no longer acquired at the time of kneading in preparation of a conductive resin constituent, it is not desirable.

[0016] Moreover, let the amount of the conductive matter added in mixture be the range of the 0.1 - 150 weight section to said mixture 100 weight section.

[0017] Preparation of such a conductive resin constituent is performed by adding the conductive matter into the mixture which consists of polyethylene and denaturation polyethylene, and distributing it. These actuation is performed by kneading using for example, a die no mill, a roll mill, etc.

[0018] In such a conductive resin constituent, since the content of the polar compound contained in this mixture was made into 0.1 - 50wt% using the mixture which consists of polyethylene and denaturation polyethylene, by adhesive strength with the metal which was excellent in denaturation polyethylene, a metallic foil can be laminated firmly and the quality of the PTC mold thermistor using this can be raised. Moreover, at the time of kneading in preparation of a conductive resin constituent, it is hard to produce the inconvenience that resin

pastes the metal part of a kneading machine, and can manufacture easily.

[0019] Moreover, since denaturation polyethylene does not bar crystallization in a chain as compared with the polyethylene in which not only a chain end but the inside of a chain denaturalized with the polar compound and it is hard to produce control of the degree of crystallinity by the polar compound, a volume resistivity is low and it has a good PTC property.

[0020] furthermore, a PTC property low [a volume resistivity] and good since the mixture which consists of polyethylene and denaturation polyethylene is used and a fault is mitigable taking advantage of the advantage which polyethylene has -- having -- in addition -- and a metallic foil is firmly laminable.

[0021] The PTC mold thermistor of this invention is a PTC mold thermistor which used said conductive resin constituent. This PTC mold thermistor comes to laminate a metallic foil to both sides of said conductive resin constituent formed in the shape of a film.

[0022] What thickness is 0.01-1.0mm and becomes from metals, such as nickel, copper, stainless steel, tin plating copper, and nickel-plating copper, as a metallic foil used here, for example is used.

[0023] In order to manufacture such a PTC mold thermistor, it is carried out by the approach of laminating a metallic foil to both sides of said conductive resin constituent formed in the shape of a film etc. Formation of a conductive resin constituent here can be performed by the approach usually performed, extrudes said conductive resin constituent, and is preferably performed using a press machine etc. by the approach of forming the shape of a film, and in the shape of a sheet etc. Moreover, the lamination of a metallic foil pierces in a circle etc. the conductive resin constituent formed the shape of a film, and in the shape of a sheet, and is performed by the approach of pasting up the metallic foil which has the same configuration as this to both sides with a heat press etc. Thus, the obtained PTC mold thermistor is used according to an application, being processed into a predetermined dimension.

[0024] what is low as for a volume resistivity and has a good PTC property in order to use said conductive resin constituent for such a PTC mold thermistor -- becoming -- in addition -- and a metallic foil can be laminated firmly and it becomes the strong thing of the adhesive strength of said conductive resin constituent and metallic foil.

[0025]

[Example] Hereafter, an example is shown and this invention is explained in detail.

(Example 1 of a trial) 90 weight sections addition of the carbon black was carried out as conductive matter, using the roll mill, it kneads in the polyethylene (maleic-acid 2wt% content) 100 weight section in which the chain end denaturalized by the maleic anhydride, it was distributed, and the conductive resin constituent was prepared. After forming this conductive resin constituent with a thickness of 0.24×0.01 mm in the shape of a sheet using a press machine, it pierced circularly, subsequently the metallic foil of the same configuration was pasted up on both sides of said conductive resin constituent by carrying out a heat press, and the PTC mold thermistor was created.

[0026] (Example 2 of a trial) The PTC mold thermistor was created like the example 1 of a trial using the polyethylene (acrylic-acid 6wt% content) 100 weight section in which the chain end denaturalized from the allyl compound acid.

[0027] (Example 3 of a trial) The PTC mold thermistor was created like the example 1 of a trial using the polyethylene 100 weight section.

(Example 4 of a trial) The PTC mold thermistor was created like the example 1 of a trial using the mixture (maleic-acid 0.1wt% content) 100 weight section which consists of polyethylene and denaturation polyethylene (maleic-acid 0.2wt% content) which carried out the graft polymerization of the maleic anhydride, and carried out the graft of the maleic acid.

[0028] Thus, among the acquired example 1 of a trial - the example 4 of a trial, the example 1 of a trial and the example 2 of a trial are examples of this invention, and the example 3 of a trial and the example 4 of a trial are the conventional examples. About each PTC mold thermistor of the example 1 of these trials - the example 4 of a trial, following measurement and assessment of each item were performed.

The volume resistivity of [volume-resistivity] ordinary temperature (20 degrees C) was measured.

The volume resistivity with a [change scale-factor] temperature of 150 degrees C was measured, and, subsequently it asked for the ratio (change scale factor) of 150-degree-C volume resistivity to the volume resistivity of ordinary temperature (20 degrees C).

The [bond strength with metallic foil] conductive resin constituent and the metallic foil were subtracted by hand, and were removed, and the bond strength was investigated and evaluated. A result is shown in a table 1. [0029]

[A table 1]

	導入した 極性基の名称	極性基 導入箇所	20℃での 体積抵抗率 ($\Omega \cdot \text{cm}$)	変化倍率	金属箔との 接着強度
試験例1	無水マレイン酸	分子鎖末端	1	10^7	○
試験例2	アクリル酸	分子鎖末端	2	10^6	○
試験例3	—	—	—	—	×
試験例4	無水マレイン酸	グラフ	4	10^5	◎

[0030] a change scale factor with the example 1 of a trial and the example 2 of a trial higher than a table 1 -- having -- in addition -- and the result that the bond strength of a conductive resin constituent and a metallic foil was excellent was brought. Moreover, in the example 3 of a trial which has not denaturalized with a polar compound, the result that bond strength with a metallic foil was low was brought, and in the example 4 of a trial for which the inside of a chain has also denaturalized with the polar compound, although the bond strength with a metallic foil was excellent, it brought the result that a change scale factor was low.

[0031]

[Effect of the Invention] As explained above, the conductive resin constituent of this invention has adhesive strength with the metal which was excellent since it made it come to distribute the conductive matter into the mixture with which a chain end consists of polyethylene which denaturalized with the polar compound, or polyethylene and denaturation polyethylene, can paste up a metallic foil on it firmly, and can use it as the conductive resin constituent which can raise the quality of the PTC mold thermistor using this. Moreover, since not only a chain end but the inside of a chain does not bar crystallization in a chain as compared with the case where the polyethylene which denaturalized with the polar compound is used and it is hard to produce control of the degree of crystallinity by the polar compound, a volume resistivity is low and denaturation polyethylene can consider as the conductive resin constituent which has a good PTC property.

[0032] furthermore, a polar compound -- 0.1 - 50.0wt% -- what was excellent in containing at adhesive strength with a metal -- becoming -- in addition -- and it can be hard to produce the inconvenience that resin pastes the metal part of a kneading machine at the time of kneading in preparation of a conductive resin constituent, can manufacture easily, and can consider as the further excellent conductive resin constituent.

[0033] moreover, the thing which is low as for a volume resistivity and has a good PTC property since said conductive resin constituent is used for the PTC mold thermistor of this invention -- becoming -- in addition -- and adhesive strength with the metallic foil used as an electrode can be made high.

[Translation done.]